



Potential sites for Integrated Earth Science Research in Deep Underground Laboratories

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Abstract (1 of 2)

There are three types of sites being considered for deep-underground earth science and physics experiments: (1) **abandoned mines** (e.g., the Homestake Gold Mine, South Dakota; the Soudan Iron Mine, Minnesota), (2) **active mines/facilities** (e.g., the Henderson Molybdenum Mine, Colorado; the Kimballton Limestone Mine, Virginia; the Waste Isolation Pilot Plant [in salt], New Mexico), and (3) new tunnels (e.g., Icicle Creek in the Cascades, Washington; Mt. San Jacinto, California). All of these sites are being considered as part of the Physic's community effort in neutrino reserach

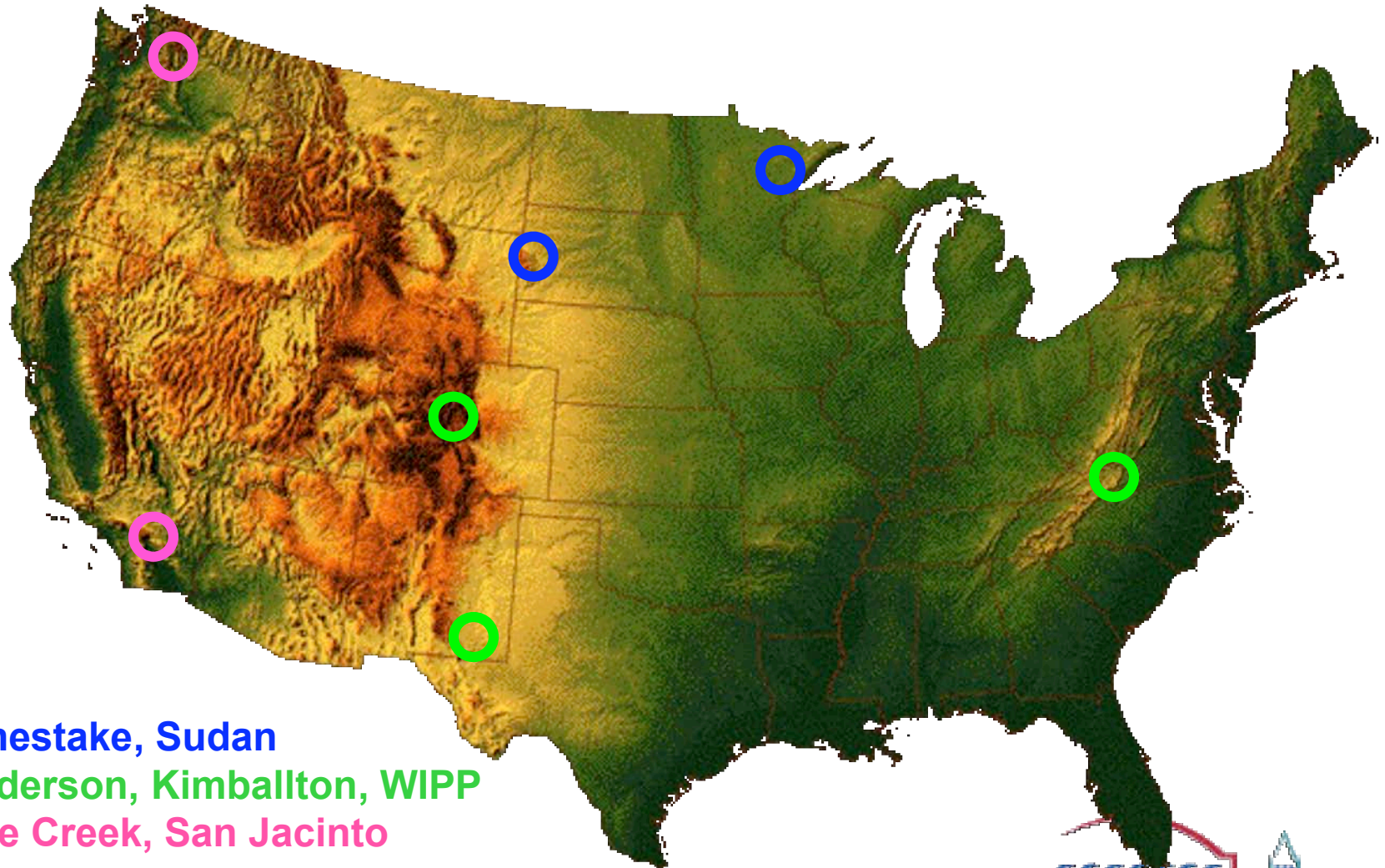
Additional sites have been considered in the geologically unique region of southeastern California and southwestern Nevada, which has both very high mountain peaks and the lowest point in the United States (Death Valley). **Telescope Peak** (along the western border of Death Valley), **Boundary Peak** (along the California-Nevada border), **Mt. Charleston** (outside Las Vegas), and **Mt. Tom** (along the Pine Creek Valley) all have favorable characteristics for consideration. Telescope Peak can site the deepest laboratory in the United States. The Mt. Charleston tunnel can be a highway extension connecting Las Vegas to Pahrump. The Pine Creek Mine next to Mt. Tom is an abandoned tungsten mine. The lowest levels of the mine are accessible by nearly horizontal tunnels from portals in the mining base camp. Drainage (most noticeable in the springs resulting from snow melt) flows (from the mountain top through upper tunnel complex) out of the access tunnel without the need for pumping. While the underground drifts at Yucca Mountain, Nevada, have not yet been considered (since they are relatively shallow for physics experiments), they have undergone extensive earth science research for nearly 10 years, as the **site for future storage of nation's spent nuclear fuels.**

Abstract (2 of 2)

All these underground sites could accommodate different earth science and physics experiments. Most underground physics experiments require depth to **reduce the cosmic-ray-induced muon flux** from atmospheric sources. Earth science experiments can be spatially extensive, from sub-room-size scale to ten-kilometer scale. The DUSEL sites with vertical depth and lateral extent can accommodate many different experiments. Hydrologic studies can characterize the in-flow along drifts, ramps, and shafts. Geophysical and rock mechanics studies can have seismic and electromagnetic sensors stationed on site, for both local monitoring of excavations and long-term stability, and mine-scale network of sensors to form a large aperture for tomography imaging. The geo-biochemical studies can include the ecological evaluation of the effects of introduced materials and the search for the origin of life in isolated fluid pockets at depth.

This type of research can further promote collaboration between earth scientists with physicists. A deep laboratory can accommodate a deep campus for suites of physics detectors, and several campuses at different depths within the same site for earth science experiments in rock mechanics, hydrology, geochemistry, ecology, geo-microbiology, coupled processes, and many other branches of earth and planetary sciences.

U.S. Abandoned Mines, Active Mines, Tunnels
with Plans to Respond to NSF Solicitation 2



Homestake, Sudan

Henderson, Kimballton, WIPP

Icicle Creek, San Jacinto

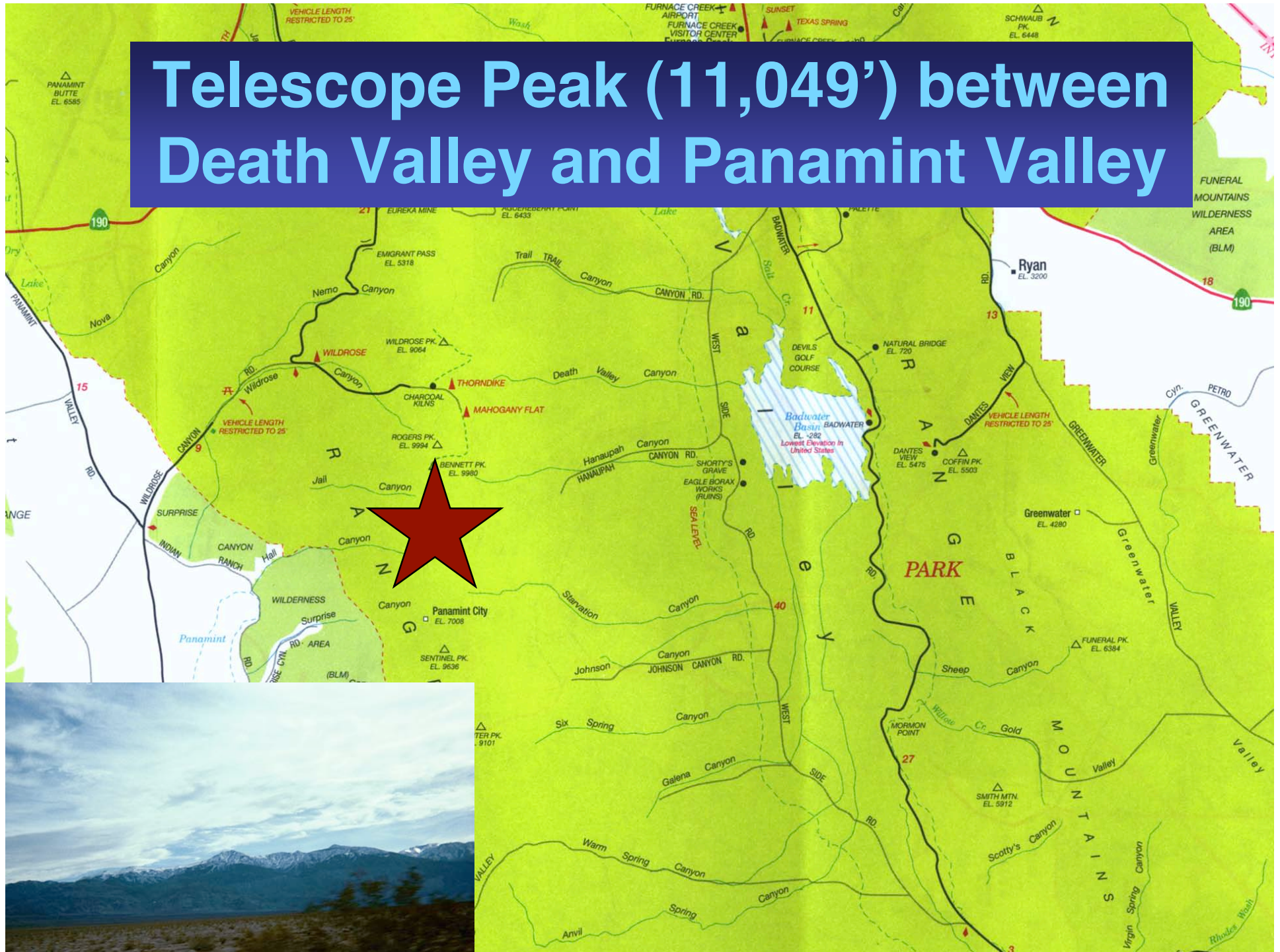
High Mountains and Deep Valleys in SE California and SW Nevada

- **Highest: Mt. Whitney (14,495')**
- **Lowest: Death Valley (-282')**

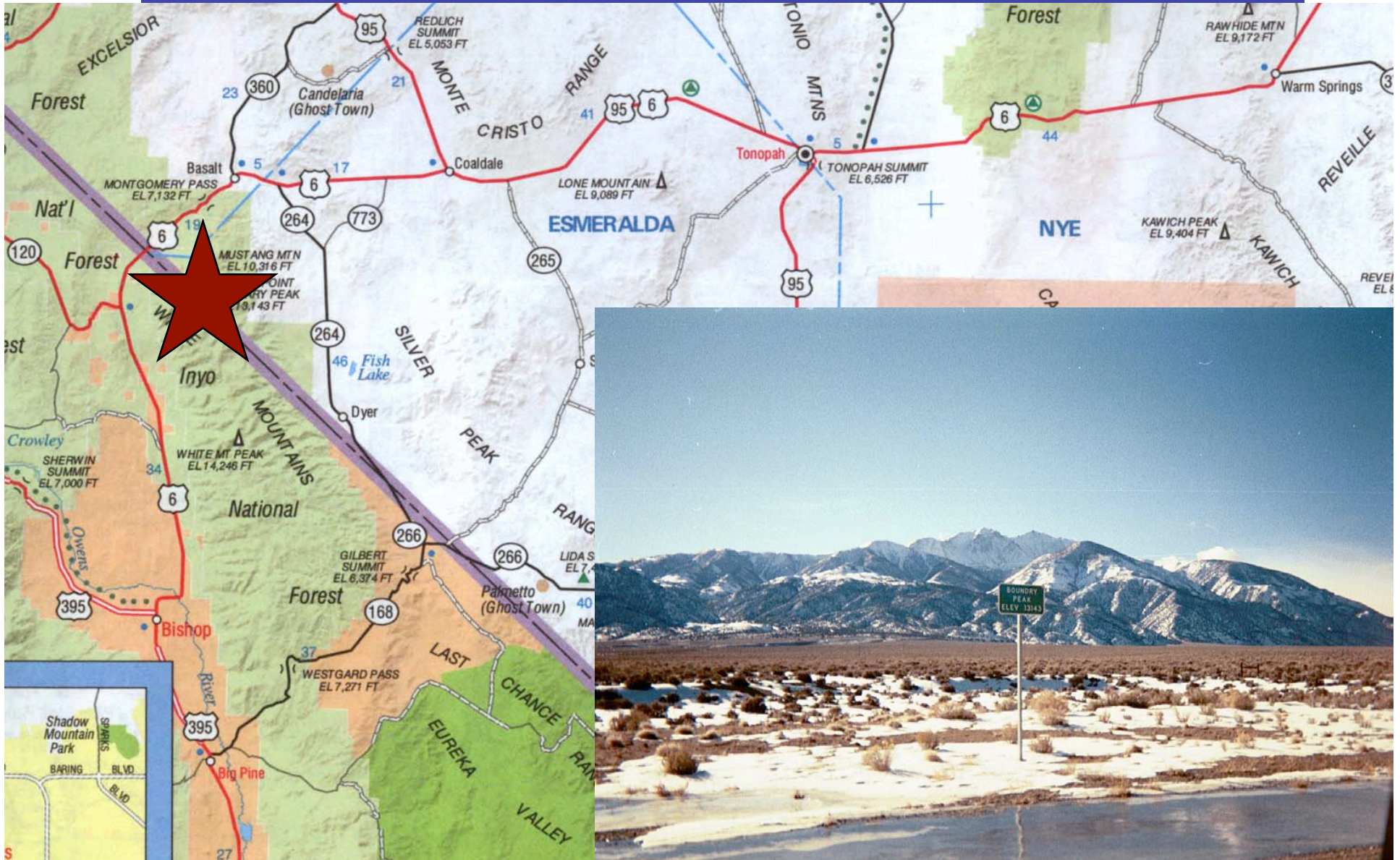




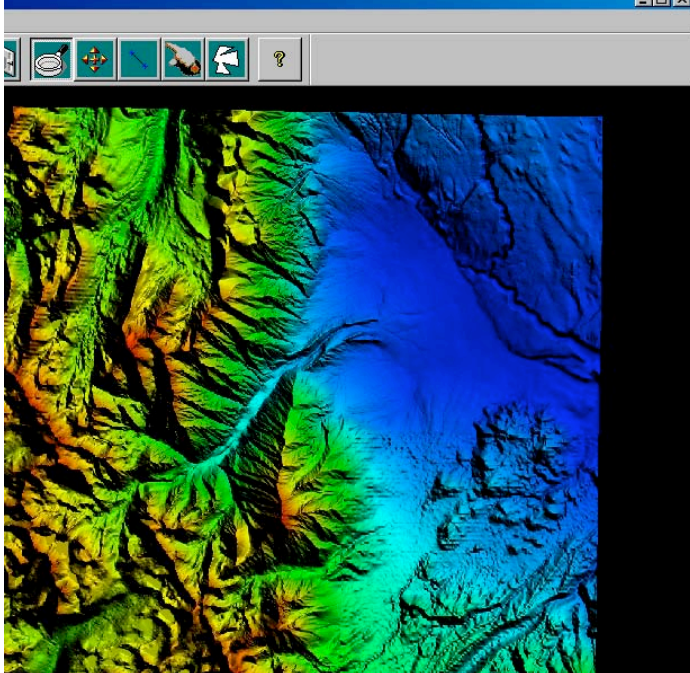
Telescope Peak (11,049') between Death Valley and Panamint Valley



Boundary Peak (13,143') between California and Nevada



Mt. Tom (13,652') along Pine Creek Next to a Mine



Pine Creek Mine in Granite

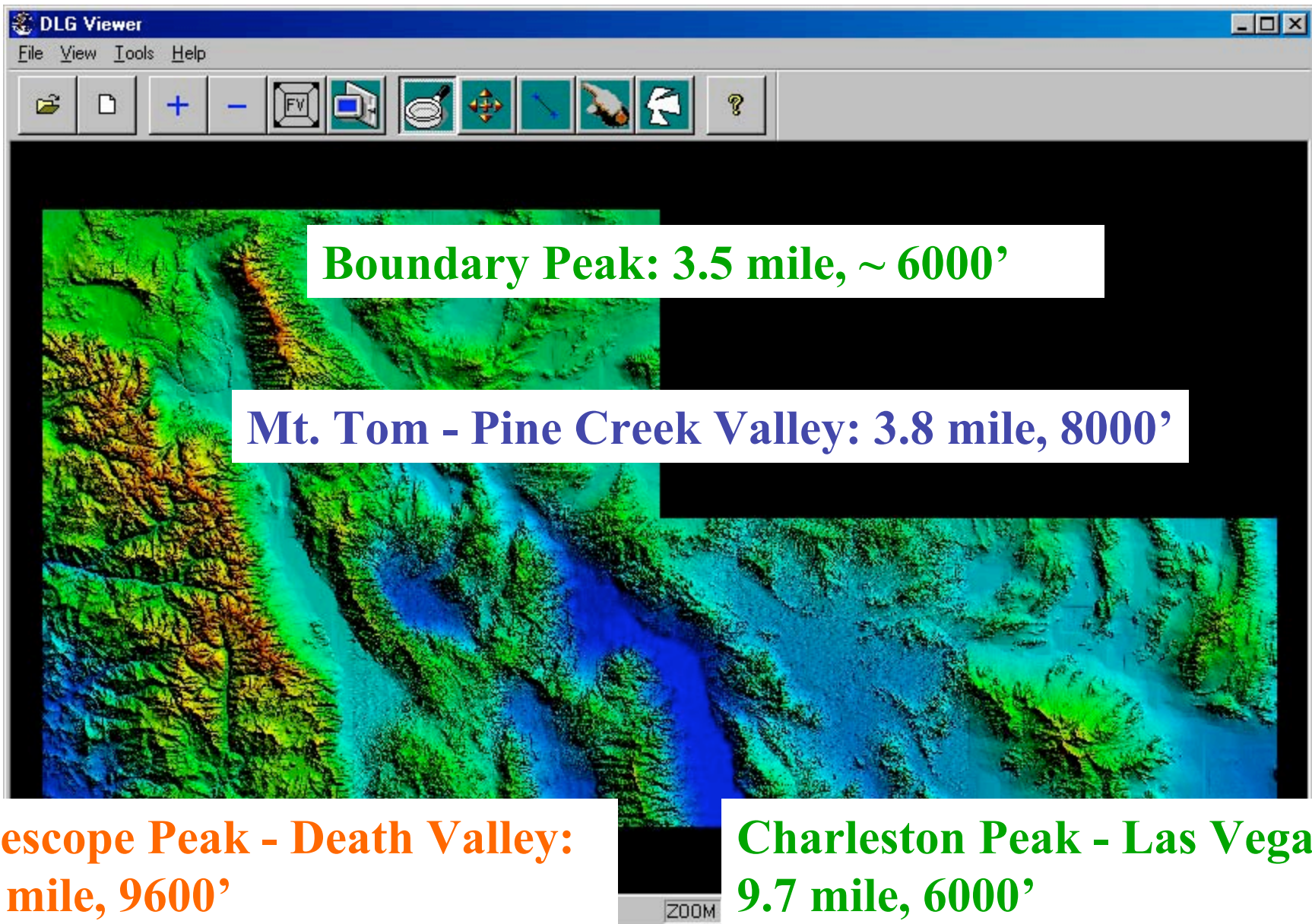
- No Support required for Long Segments



Water Observed in Pine Creek Mine and Drain Out Without Pumping



Nevada/California Sites (with 1% up-gradient tunnel)



Summary

- **National Science Foundation has issued two calls for proposals, with six-month durations on**
(1) site-independent research definition and infrastructure requirement (submitted September 15).
(2) site development and conceptual design for Deep Underground Science and Engineering Laboratories (due in early 2005)
- **Seven sites are preparing proposals to NSF Call for S-2 DUSEL Development**
- **Four CA and NV sites are being considered in carbonate and granitic sites.**
- **Cosmic Ray Tomography is a possibility for physics-earth science collaboration in all sites.**

